

On the behaviour of the African bolas-spider *Cladomelea akermani* Hewitt (Araneae, Araneidae, Cyrtarachninae), with description of the male

by

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ABSTRACT

The male of *Cladomelea akermani* Hewitt, the first known in the genus, is described, and the female redescribed. Observations on the species' prey capture behaviour reveal that details of the initial description of these habits were not correct. The possible link between particular morphological characters and the behaviour is discussed.

INTRODUCTION

Like many other representatives in the subfamily Cyrtarachninae, *Cladomelea akermani* constructs a highly modified orb web (Scharff & Coddington 1997). Adult females use a length of silk ending in a sticky droplet (the bolas), which they twirl to capture prey. *Cladomelea akermani* was first described by Hewitt (1923). Akerman (1923) subsequently described its prey catching behaviour, based on observations he had made in 1915. He had read Longman's (1921) paper on *Ordgarius magnificus* (Rainbow), which probably influenced his recollection of the behaviour of *C. akermani*. His description has been assumed correct and has been reiterated by subsequent authors, for example Eberhard (1980) and Stowe (1986).

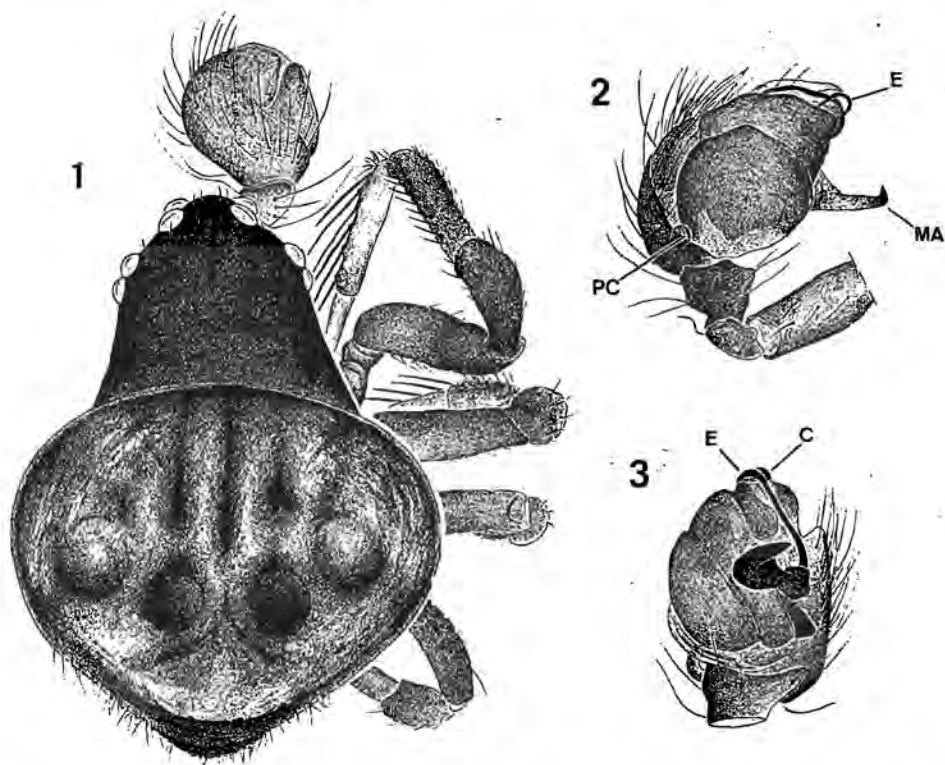
During field work carried out by J. and A. Leroy at the Umgeni Valley Spider Reserve, with the intention of making a video film on bolas-spider behaviour, observations were made suggesting that the initial description of the way *C. akermani* twirls its bolas and catches prey, is not precise. The purpose of the present paper is to correct this and to describe the male, which was unknown. Moreover, it is the first male to be described in the genus, which contains three species: the type species *C. longipes* (O. P.-Cambridge), *C. ornata* Hirst and *Cladomelea akermani* Hewitt.

MATERIAL AND METHODS

The study was carried out at the Umgeni Valley Reserve near the town of Howick, in the province of KwaZulu-Natal, South Africa – the second recorded locality for *C. akermani*. *C. akermani* is found in open grasslands, both in short grasses such as *Themeda triandra* which grows to about 40 cm, and very tall grasses such as giant

turpentine grass, *Cymbopogon validus*, which grows over 2 m in height. So far, adults have only been found on grasses and not on other plants. Adult female *C. akermani* are found towards the end of the summer (March), and into autumn.

During the day we found and marked the positions of five adult females and returned at night, for four nights in succession, to observe and record their behaviour and document it photographically. As each spider was visited twice per night, the total number of field observations was 40. On the last night we collected two adult female spiders, one of which was immediately preserved and deposited in the National Collection of Arachnids in Pretoria as a voucher. The other specimen, together with two egg sacs already attached to a grass stem, was kept alive in Johannesburg so that we could observe, photograph and videotape it in a controlled environment, and compare its behaviour to that observed at Umgeni Valley Reserve. We placed this spider along with its egg sacs attached to the grass stem, amongst a bunch of dry grass to simulate its natural habitat. During the day it was kept indoors to protect it from predation and taken outside at night to see if local moths might be lured by the expected pheromones. Johannesburg is approximately 700 km from Umgeni, on the Highveld plateau (alt. 1750 m), where the climate, vegetation and fauna are very different from those in the KwaZulu-Natal midlands. The videorecorder used was a Sony 6xzoom CCD-F255E (shutter-speed 1/120 sec).



Figs 1-3. *Cladomelea akermani*, male. 1. Habitus, dorsal view. 2. Palp, retrolateral view. 3. Palp, ventral view. [C = conductor; E = embolus; MA = median apophysis; PC = paracymbium.]

The specimen's behaviour was recorded and videotaped regularly over a period of 15 nights, during which time it constructed its trapeze web and several bolas's, at regular intervals. Moths were hand-fed to the spider and those between the sizes of approximately 5 and 15 mm were readily accepted, and wrapped in typical araneid fashion before being eaten.

Abbreviations are standard as in Croeser (1996: 5). All measurements are in mm.

RESULTS

Material examined

SOUTH AFRICA: *KwaZulu-Natal*: Female holotype: Pietermaritzburg, vii.1915, C. Akerman (NM 7017); 1 juv.: Pietermaritzburg, iv.1946, Burg & Holiday (NMSA4627); 1 female, 1 male: Howick, Umgeni Valley Reserve, 12.iv.1992, on *Digitaria eriantha*, J. Roff (NMSA); 1 female, voucher specimen (mentioned above): Howick, Umgeni Valley Reserve, 21.iii.1992, J. Leroy (NCP LR 972).

Description

Male (Figs 1–3): Total length: 1.40; carapace 0.92 long, 0.72 wide; tibia + patella I: 0.88 long.

Colour and markings: Carapace dark chestnut-brown; chelicerae and sternum dark brown; legs medium brown, faintly banded; abdomen: dorsum gray with large pale folium; venter dark.

Eyes: AME: 0.01, ALE: 0.06, PME: 0.01; PLE 0.04. MOQ quadrangular: 0.26 wide. *Clypeus* 0.16 high or 1.6 times width of AME. *Sternum* 0.42 long, 0.50 wide.

Legs: Anterior legs with row of prolateral spines: I: T 10 Mt 8 t 3; II: T 9 Mt 6 t: 2.

Measurements:

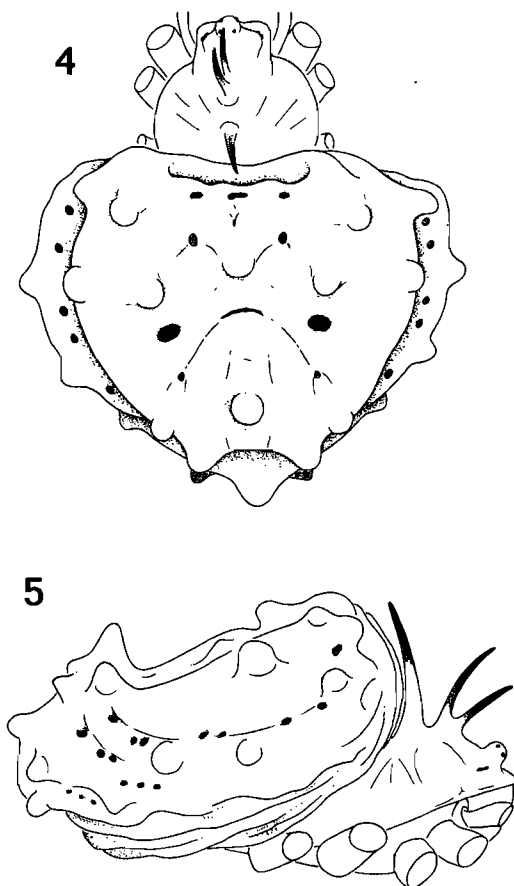
	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	0.74	0.32	0.60	0.46	0.34	2.46
II	0.68	0.26	0.48	0.40	0.28	2.10
III	0.38	0.20	0.24	0.20	0.28	1.20
IV	0.52	0.22	0.36	0.22	0.30	1.60

Abdomen with 2 tubercles, and 2 sigilla between them. *Palp* (Figs 2–3): Remarkably simple; tibia without macrosetae; cymbium prolateral, with small, rounded paracymbium near base; median apophysis large and hook-shaped, smooth; conductor (?) a poorly delimited, distal swelling of the tegulum; embolus originating on dorsal part of tegulum, long and whip-shaped, anticlockwise on right palp.

Female (Figs 4–7) (measurements show range of 3 females): Total length: 12.0–15.1; carapace 4.4–5.1 long, 4.8–5.3 wide; TI+ PI: 9.9–10.0 long.

Colour and markings: Carapace yellowish brown, the long median excrescences tipped with black; sternum and chelicerae yellow; legs pale brown with extremity of metatarsi and tarsi black; abdomen pale cream.

Carapace (Figs 4–5) hirsute, with 3, long, sharp-tipped excrescences; *chelicerae* bluntly conical, anterior margin with 3 teeth, posterior margin double, consisting of



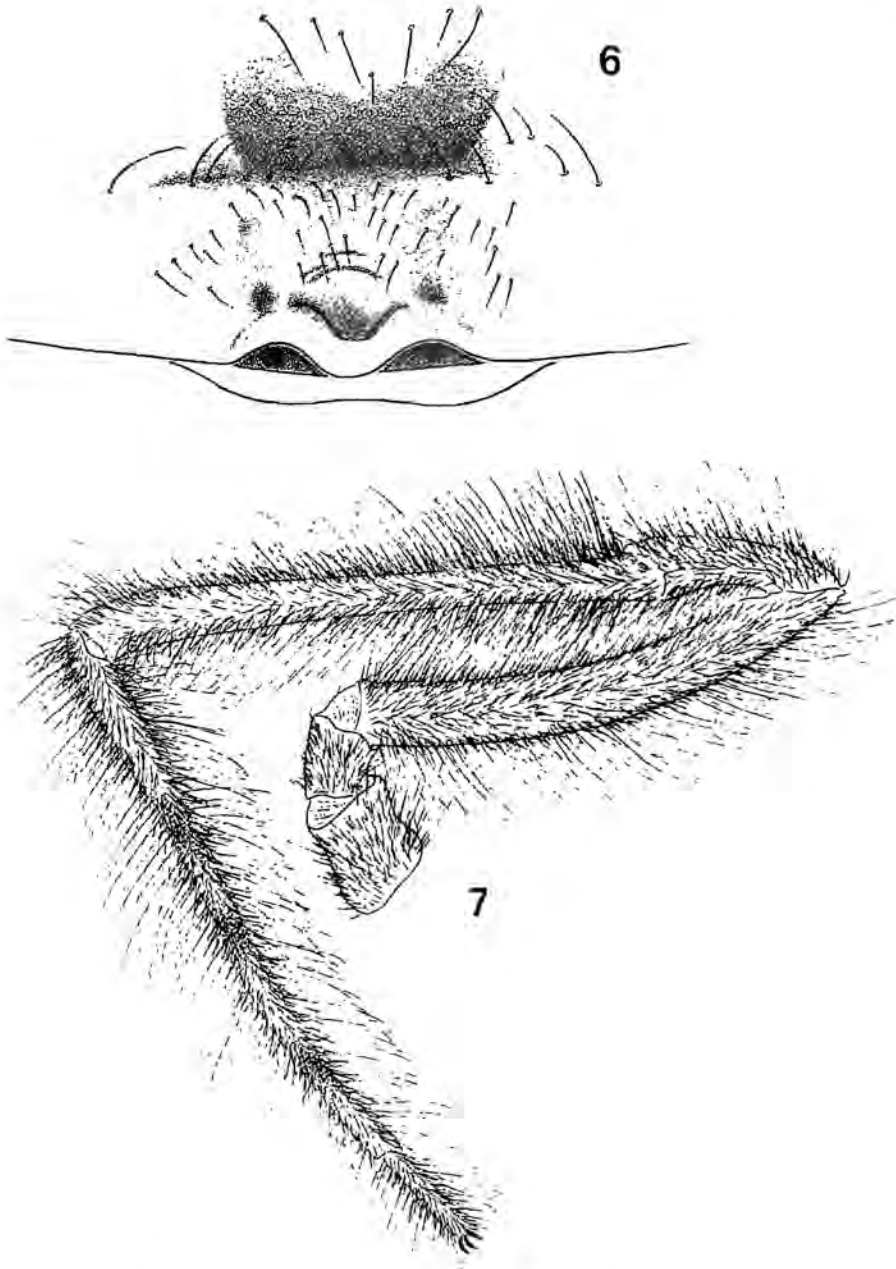
Figs 4–5. *Cladomelea akermani*, female, habitus, outline. 4. Dorsal view. 5. Lateral view.

3+3 teeth and with a group of denticles between both margins. *Eyes*: Both eye rows recurved (as seen from above); median eyes on common tubercle; MOQ as long in front as behind; lateral eyes each on a shallow tubercle. *Legs* I and II much longer than III and IV; anterior leg pairs with dense cover of thin hairs, about 3 times as long as the diameter of the segment. Mt IV with one trichobothrium.

Measurements (largest female):

	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	6.5	2.4	7.5	7.0	1.2	24.6
II	4.9	2.0	4.6	5.1	1.1	20.7
III	3.0	1.5	2.0	1.8	0.8	9.1
IV	3.9	1.9	2.9	2.4	0.8	10.9

Abdomen with rows of tubercles: 2 rows, with resp. 5 and 6 tubercles in front; the last but one on each side sclerotised; 3 rows with 8 tubercles in all at the back. Sigilla scattered. Booklung covers with row of deep grooves. Spiracle not sclerotised.



Figs 6-7. *Cladomelea akermani*, female. 6. Epigyne. 7. Leg 1, showing thin setae.

Epigyne : Fig. 6.

A remarkable characteristic of this species is the presence of a double row of teeth on the inferior cheliceral margin and of denticles inbetween both the margins, a

character state so far unrecorded in Araneidae (Scharff & Coddington 1997). It is also present in *C. longipes* and '*Acantharanea*' *lesserti* (Giltay).

The habitus of *Cladomelea* is fairly similar to that of other bolas-spiders. A major difference is the absence of prolateral spines on the front legs of the female. These legs are long and densely covered with long, thin setae. This feature is also found in an undescribed species recorded from Madagascar by Emerit (1978, Fig. 3), and possibly belonging to *Acantharanea* Strand (mentioned under *Acantharachne*) and in *Acantharanea lesserti* (female holotype examined), which will have to be transferred to *Cladomelea*. The difference in size and ornamentation of the front legs might be a clue to explaining the differences in prey capture behaviour among *Mastophora*, *Ordgarius* and *Cladomelea*.

Behaviour

During the day, female *C. akermani* sit motionless on grass stems with their legs curled up, often near their egg sacs, which are also attached to grass stems. Our observations indicate that they are most active on dry, moonless nights. The peak periods of activity are from sunset to about midnight. The adult female commences web construction after sunset. A trapeze of non-viscid silk is attached between two grass stems. From the middle of this trapeze a short, vertical line of non-viscid silk is attached. This short line does not normally exceed 75 mm in length. At the end of it, a clear, very sticky substance is produced, which coats the last ± 15 mm. When this line is released by the spider, it hangs down and the sticky substance forms one, or occasionally two, large clear globules. The line, together with the globule, is known as the bolas. With the bolas hanging from the centre of the trapeze the spider positions itself sideways, holding the trapeze with legs II, III and IV on the upper side (Fig. 8a). With legs III and IV on the lower side, held tucked away under the body, it holds the bolas line with leg II. The swinging of the long front legs (legs I) causes the bolas, held by leg II, to rotate. Legs I are held straight out and swung back and forth horizontally through about 320 degrees. The movement is almost entirely due to the very supple front legs and cephalothorax, whereas the anchor legs and the web itself remain almost motionless. Leg II acts as the axis around which the body oscillates and the bolas rotates. This rotation starts slowly at first (Figs 8a–c); as the bolas gathers speed it rises till it rotates in an almost horizontal plane (Figs 8d–e), and appears blurred to human sight. It then passes near the swinging front legs, as can be seen in Fig. 8e. We filmed the twirling and timed it at about 150 revolutions per minute. The spider continues to swing the bolas for a maximum of 15 minutes at a time, but if nothing has been caught it retrieves the bolas, ingests part of the line, sticks the globule to the edge of the web and starts all over again after a few minutes.

In its natural habitat it usually catches prey, exclusively moths, during each twirling bout. In captivity it was unsuccessful in catching prey, although in every other respect its behaviour was the same.

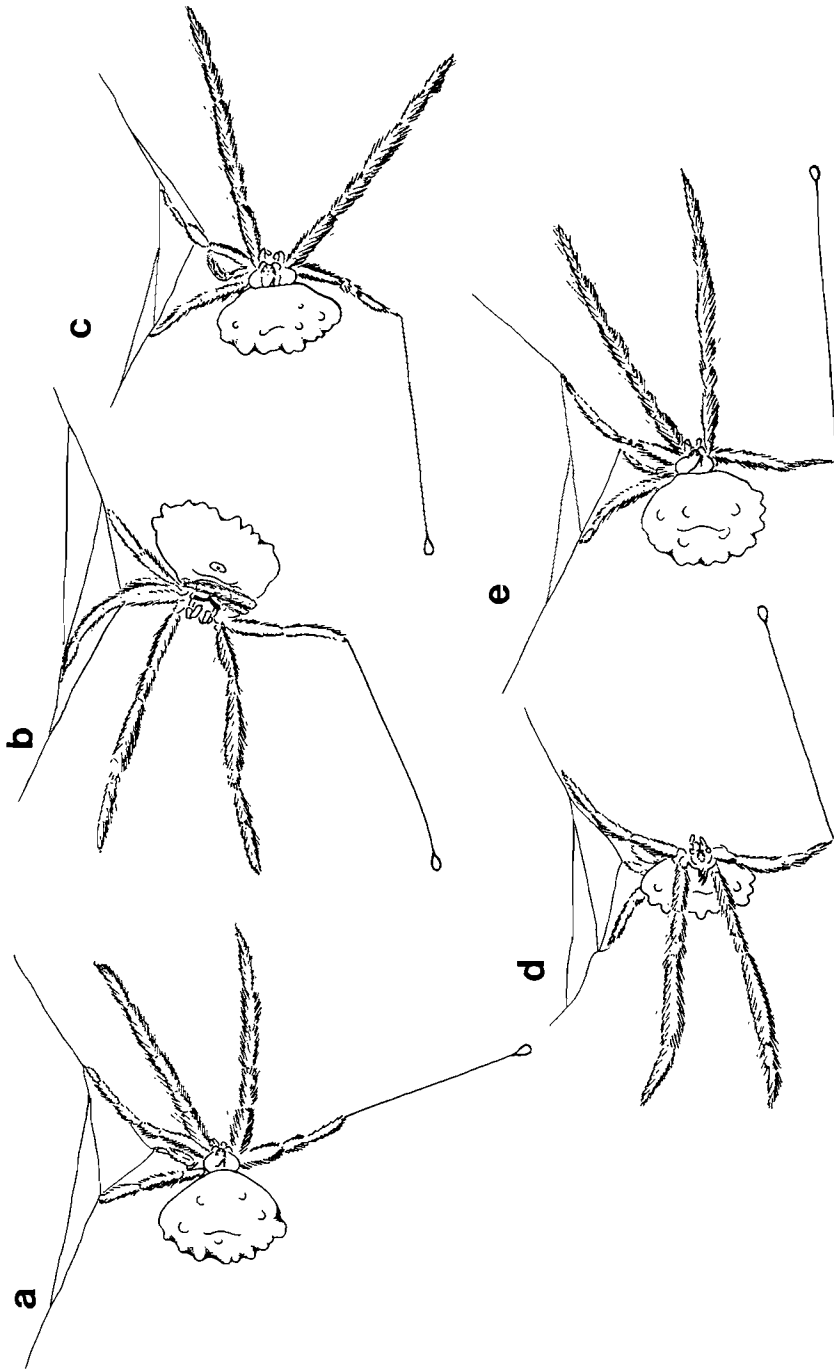


Fig. 8. Diagrammatic sketches of bolas twirling by *Cladomelea akermani*, showing how the rapid swinging of the front legs causes the bolas to rotate in an almost horizontal plane.

DISCUSSION

From our observations it is clear that *Cladomelea* holds its bolas with the second leg and not with the third as claimed by Akerman (1923). Yet, his photo (Fig. 7) shows the bolas hanging from the third leg. However, this picture is a reconstruction using a dried specimen, for which the third leg was provided with a bolas by Akerman himself.

It is possible that *Cladomelea*, as with *Mastophora*, uses pheromones to lure its prey, more precisely imitating female moth sex attractants to lure male moths. However, the few moths that did approach during our Johannesburg observations might have been attracted by a pheromone assumed to be involved in prey attraction, as well as by the lights on the terrace. As none of them were captured by the spider, we suppose their presence was coincidental.

Examinations of prey remains taken from the spider's web in the field revealed only moth carcasses. The few that were identified appeared to be males (P. Croeser, *pers. comm.*). Although this is not proof that pheromones play a role, it might indicate that *C. akermani* has a similar strategy to the representatives of *Mastophora* studied by several authors (Eberhard 1977; Stowe 1986; Stowe *et al.* 1987; Yeargan 1988). Since these pheromones are highly specific, this would obviously limit the spiders' geographical and temporal distribution to the localities and seasons of activity of the particular moth prey.

It is not clear yet whether in *Mastophora* the chemical is emitted from glands on the spiders' forelegs or is incorporated in the bolas, or both (Lopez *et al.* 1985). A puzzling observation though, is the enormous effort that is expended by *Cladomelea* to rotate the bolas. The swaying of the front legs during prolonged periods obviously consumes a large amount of energy. One possible reason for this is that the bolas has to gather speed to make sure that when prey is hit, the contact is strong enough, and no escape is possible. A second possibility may be that the forelegs with their long cover of thin setae help to disperse the pheromones, assuming that *Cladomelea* uses them in its bolas. The fact that the sticky globule passes very close to the front legs may help to disperse the pheromone. An argument for this assumption might be that *Cladomelea* changes its bolas after 15 minutes, even though it remains sticky. This could mean that the pheromone in it has evaporated by then, and that a new bolas is needed to replace it. *Cladomelea* is the only bolas-spider genus in which the female lacks a row of spines on the anterior legs, but has a dense cover of setae instead. It is likely that this character is derived, as in the males the row of spines is still present. The length ratio of the front legs to that of the posterior pair (2.3) is also much higher than in *Mastophora* (e. g. 1.6 in *M. dizzydeani*, Eberhard 1980), another feature that may be associated with the ability to create air movement to disperse pheromones.

This could mean that *Ordgarius* represents the most ancestral condition and that an evolution has taken place in two directions: in one the continuous twirling has remained, but an adaptation of the front legs helps to disperse the pheromone; in the other the hold of the bolas has shifted from the second to the first leg, which was necessary to increase the precision when flicking the bolas. It might be revealing to check whether the distribution of other characters, for instance the presence

of a third row of teeth and denticles on the chelicerae, is congruent with this hypothesis.

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